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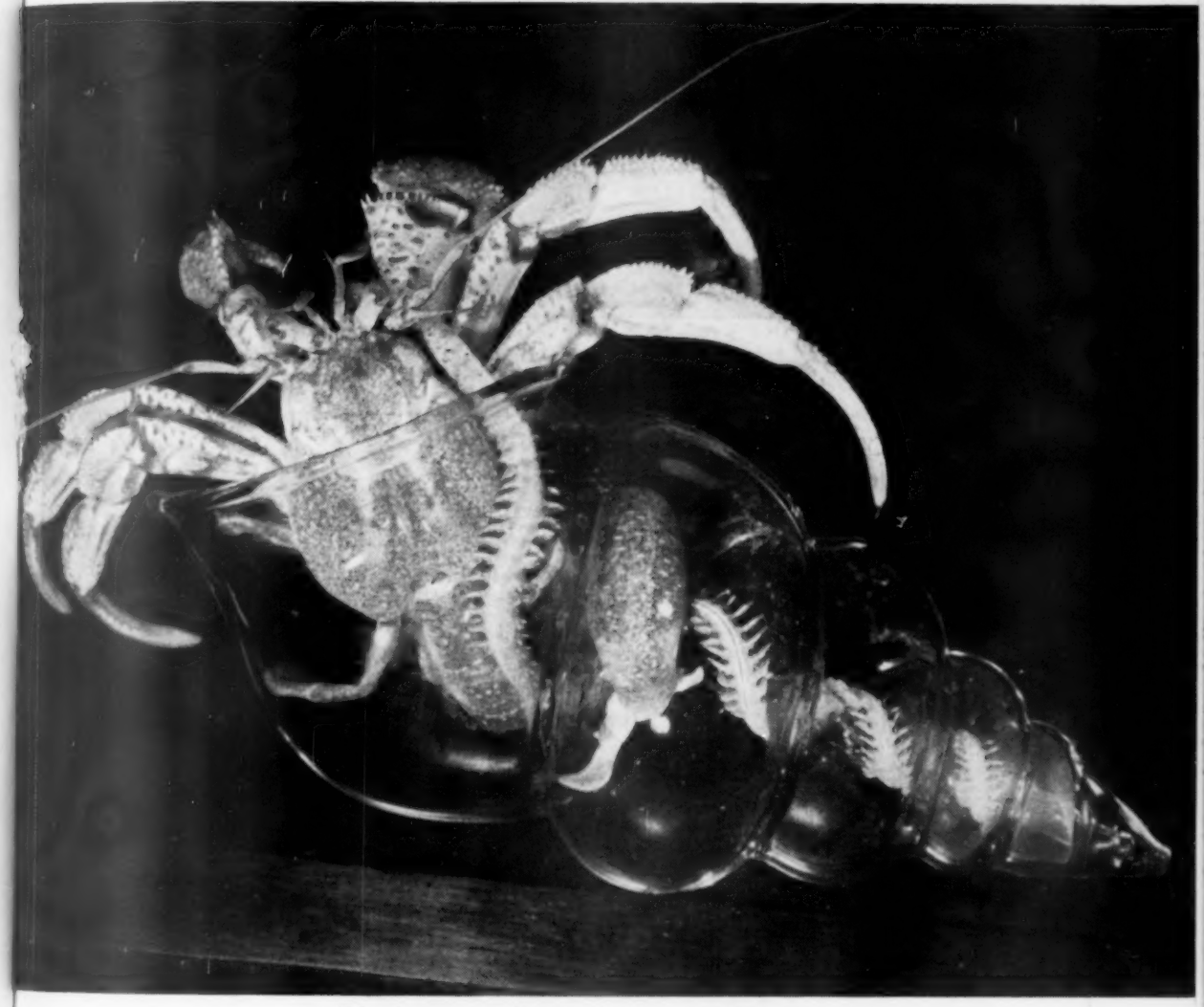

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## Cover Photograph

*Eupagurus bernhardus*, the hermit crab, has accepted a glass model of a snail shell for its house. This reveals the behavior of its annelid commensal (*Nereis fucata*), which here (above) at rest occupies the smallest coils of the shell away from its host. As soon as the crab begins to eat, the commensal comes to the opening of the shell and snatches a morsel from its host. Marine Biological Laboratory, Plymouth, England. (Photo by Ralph Buchsbaum.)


## THE AMERICAN BIOLOGY TEACHER

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## BASIC ECOLOGY

BASIC ECOLOGY, Ralph and Mildred Buchsbaum, 192 pp., Boxwood Press, Pittsburgh 13, Pennsylvania. 1957.

In this short book, the Buchsbaums have discussed the basic principles of ecology. The explanation of each principle is clear, concise, and explained by carefully chosen illustrative examples. After a discussion of "What is ecology?" they consider the physical and biotic environment. This is followed by a description of communities and their dynamic aspects. Throughout the book reference is made to the importance of ecology in human affairs.

The language of the book is clear and as simple as the subject matter permits. It is written at a level that can be understood by a high school student. The book is crowded with excellent photographs and imaginative drawings. It definitely will stimulate the interest of the student in the important fields of ecology and conservation. It seems destined to become a standard teaching aid in high school and college biology courses.

Clarence J. Goodnight, Professor of Zoology, Purdue University

*(See advertisement Page 124)*


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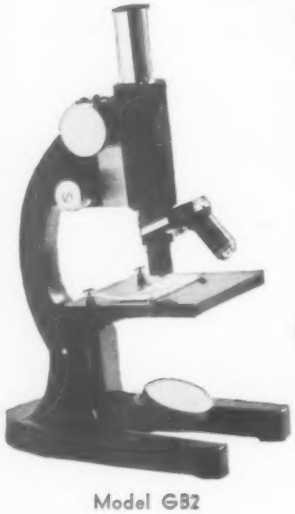

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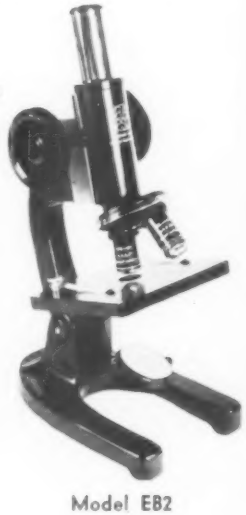

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# Toward a Better Understanding of Animal Life

PAUL L. ERRINGTON

*Zoology and Entomology Department, Iowa State College, Ames, Iowa*

I do not think that most youngsters are taught what science is early enough. Otherwise, science would not be so often looked upon as merely synonymous with technology and gadgetry. A more wholesome attitude would result, it seems to me, if science were introduced in the classroom as being essentially the search for truth, and a scientist as one who experiments and observes, analyses and tests, and attempts to extract the soundest conclusions from the information available.

Seldom if ever am I troubled by anyone's inability to retain in his memory a collection of miscellaneous detail. Failures to winnow the big facts out of the little facts and, most of all, the persistence of grossly erroneous concepts are what I regard as more symptomatic of educational shortcomings. In connection with my own work, I am particularly conscious of shortcomings in public thought in the field of wildlife conservation (or wildlife management, if an expression implying for some people a less passive approach is preferred); and this article will, accordingly, be largely concerned with conservation aspects of biology.

Complexities in natural relationships are, of course, a major reason for students missing as much as they often do in their biological training, whether in formal classwork or outside of school. Students surely need cautioning against accepting "the obvious" too much at face value. One of the most illuminating examples of "the obvious" misleading is furnished by mink predation upon muskrats. I have already used it many times in my writing and talking but perhaps may be justified in using it again.

The conviction persists among naturalists, trappers, game wardens, and other outdoorsmen that minks exert a severe depressive influence upon the muskrats, and it is perfectly understandable why this conviction should persist. Anyone who spends much time where both minks and muskrats live may sooner or later see evidence of minks eating muskrats, of minks sometimes subsisting upon muskrats for weeks at a time, and of minks sometimes leaving dead muskrats in piles. Minks, besides showing a strong preference for muskrat flesh, are the most formidable of wild predators with which muskrats are usually associated over wide areas of North America.

But analysis of nearly a quarter-century of detailed field notes on mink-muskrat relationships leads to the conclusions that: (1) what looks like the severest predation by minks upon muskrats is unlikely to be predation at all and simply represents scavenging upon the bodies of muskrats dying from epidemic disease; (2) when genuine mink predation upon muskrats does occur, it tends to be centered upon individuals living under pronounced if not overwhelming handicaps, such as overproduced young or upon parts of populations exposed by drought or evicted by deep-freezing of shallows or beset by much restlessness and friction; and (3) social intolerance of the muskrats, themselves, between muskrat and muskrat, is usually the chief factor limiting the population levels reached by the muskrats—that is, within the environmental limitations of the places in which the muskrats are adapted to live. In short, muskrats usually do not have to let themselves be killed by minks as long as living conditions are in their favor, and minks are usually exploiters of wastage parts of muskrat populations. This puts both minks and muskrats in quite different predator-and-prey categories than the public is apt to have in mind.

Nevertheless, the complexities and obscurities in natural relationships should not be held up to discourage original observations by the public. I think it commendable that teachers stimulate students to observe wildlife and wildlife dramas and try to interpret what they see. This, if suitable guidance is provided, can be a most superior method of teaching.

I think, furthermore, that introductory biology should be planned to instill in a student a realistic objectivity. I see the need for objectivity especially when thinking of the reactions of the public toward animals that arouse displeasure. We may grant that mankind can have problems in protecting its own interests against troublesome wild animals and that almost anything alive can be a pest to human beings under some conditions. Still, there is no reality in judging wild animals by human moral standards, in considering the animal morally bad because it eats flesh or because it does not eat the right kind of flesh to suit farmers or someone else; or, even if it is a plant eater, to judge its morals on the basis of what it eats or where it digs or whether it messes up the premises. If reduction in numbers of this or that species is necessary, measures may be carried on as efficiently, matter-of-factly, and humanely as possible—not as part of a program to punish wild animals for behaving like wild animals.

It should be possible to supplant by more rational attitudes the prejudices nourished by anthropomorphisms and the terminology of extremists. Why should interesting and beautiful wild creatures bear the odious designation of "vermin" because they may—actually or only presumably—compete with or prey upon game? Youngsters are capable of recognizing, when such is clearly pointed out and emphasized, that wild animals live much as they can, in just about any place that they can, entirely in accordance with the limitations imposed by Life upon living things. Descriptions of wild creatures in broad terms of how they are adapted to live in the ways that they do are readily understandable even to young children. The killing by a fox of a rabbit that cannot get away has its parallelisms in the nibbling by a rabbit on whatever it finds in front of it on which to nibble. The killing of quail or of mice by predatory birds reflects opportunities and adaptations – nothing in moral choices. By avoiding misapplications of goodness and badness early, we may have less of the "Oh-the-wicked-hawk" or "Nature's gangsters" or similarly inappropriate exaggerations later.

The "What-is-it-good-for?" way of thinking also needs working on by the teacher. I have seen many unfortunate by-products of conservation education resulting from overemphasizing monetary values of wildlife. The inference is frequently left that the practical world can just as well get rid of the wildlife that is not demonstrably worth money from the standpoint of agriculture, tourist trade, game, fur, etc. As long as the justification for interest in wildlife is so restricted, we may hardly expect other than narrowness and short-sightedness in public reactions toward wildlife. Why can we not come right out and say that our real justification for protecting wild creatures is that we like to have them around or that they rightfully belong in the out-of-doors? This should eliminate a great deal of strained logic, such as in rating the broad-winged hawk as "harmful" on the ground that it includes "beneficial" insect-eating reptiles and amphibians in its diet, or in claiming practically for protecting seed-eating songbirds because of their stated help in controlling weeds.

As relates to what has value to whom, we as a people need far more effective training in perspective than we evidently are getting. Would it be desirable for teachers to call more attention to the general theme of reciprocal courtesy in outdoor matters? Something following the pattern: Because you are interested in that and I am interested in this, we both should be entitled to consideration as long as we are properly mindful of other peoples' rights in the pursuit of our interests.

I do not underestimate the difficulties of putting subtle distinctions across in either juvenile or adult education, but it should not be so hard to emphasize our collective responsibilities for safeguarding very special values. When interests are mutually exclusive, and the public has to take sides, it would be prepared to do so more intelligently if it had more early practice in distinguishing between the different values at stake—in distinguishing, for example, between the commonplace and the irreplaceable. A dozen native wolverines in the High Sierras should have infinitely greater public worth as outstanding rarities than all of the game they could possibly destroy. Or the choice may be between keeping wild and undespoiled a shrinking wilderness remnant in a region that has no wilderness

White footed mouse and family—"there is no reality in judging wild animals by human moral standards."
*Photograph by Richard F. Trump, Ames High School, Ames, Iowa*

to spare or converting it into another summer resort or into another tract of agricultural land.

* * *

For year and years, I had no satisfactory answer whenever anyone asked me what I could recommend for general reading in natural history or wildlife conservation. A tremendous literature on such subjects appeared, but most of the best work was too technical to appeal to anyone who did not care to specialize in it, and the really good popular writings dealt only with restricted phases and were scattered virtually everywhere throughout hundreds of periodicals.

Finally, in 1954, Funk and Wagnalls published Durward Allen's "Our Wildlife Legacy," an excellent book of broad scope and informative purpose for "the intelligent lay public." The author's style combines the best features of informal newswriting and philosophical analysis, and, to anyone who can read with the facility reasonably to be expected of an advanced high school student, the text offers the equivalent of a first-class introductory course in wildlife ecology and conservation. The standing of the book with the people professionally engaged in the wildlife field is illustrated by the fact that it received one of the two awards on conservation education given by the Wildlife Society in 1955.

Dr. Allen wrote the book for, among others, the teacher. It compiles interesting and significant facts and summarizes high points so well that it should be a timesaver for any teacher organizing coursework dealing with

modern conservation. The book begins with Indians and buffalo and then brings in the white man. The chapters that follow are treatments of basic ecology, of fluctuations in abundance of animals, of mistakes and progress in handling wildlife resources, of politics and esthetics and human rights. It makes plain that we, as human beings, may do the wrong things on occasion, but that we should not be satisfied to do them over and over. History cannot repeat itself too often as concerns some mistakes and still leave us much with which to try again.

The book is not one from which anyone may learn everything that is worth learning merely by hasty reading, but it is so readable, well-organized, and authoritative that an interested person could hardly avoid becoming better informed if he reads any of it at all. At any rate, it is one book that I would unhesitatingly put in front of anyone who can read English, whether he be a fast or a slow reader, a thorough or a casual reader, a hunter or a non-hunter—particularly if he be a student who will have the leadership responsibilities of the future.

---

# Why Learning?

OSCAR RIDDLE
*Plant City, Florida*

The brain arose and arrived as an organ of survival, not for thinking. Most, not all, humans can acquire the status of a thinking being, only through *learning* to think. And that kind of learning is always possible only to those reared in communities of men who have developed articulate language and somehow recorded their past experience in it. These are the astonishing and firmly rooted facts—still ignored or diligently neglected in our schools—about ultimate, compelling and majestic *rewards* of learning to think.

Before those basic facts were acquired in biological research, mainly in the last half of the previous century, they could of course serve neither as guide nor spur to thought and learning. Until they were established in science, and thus became available to the schoolmaster, these prime facts and their sweeping implications could provide no generation of youth with either a confirmable view of self or connect learning with its deepest and most excited roots. Though that accomplishment is already at least two generations behind us, who will now say that, at last, this illuminator of self and this ardent incentive to learning have found potent place in the schoolrooms of today? To the alert observer of the current pedagogical scene few points are clearer than that the items grouped in paragraph one are now taught in the better colleges of our country, and in that minority of better colleges only. For the youth of pre-college age—the millions in most urgent need of outlook on life, and also least provided with incentive to learning—those items are still a closed or a surreptitious book. Perhaps that book can often be opened in the secondary school (or even earlier) if the resourceful biology teacher casually and informally utilizes this unusual approach to the startling attractiveness and necessity of learning. Certainly the biology class offers and invites opportunities for the test—tentative or otherwise.

Teachers trained in zoology—particularly in such of its segments as evolution, neurology, behavior, and anthropology—will be familiar with the studies which establish the facts and principles listed in paragraph one. Those studies stretch to our time, but they are largely rooted in the efforts of Darwin and Sir J. G. Frazer (The Golden Bough).

The experience and training of many or most teachers of biology in secondary schools provide them with their own apt and convincing illustrations of the inability of the normal human brain—apart from *learned* language and *learned* modes of behavior and thought—to lead to or ultimately become part of a *thinking* organism. Nevertheless, for some

teachers a few references to subject matter of this nature may prove helpful. Of course, we at once meet the prime fact that language is essential to all *abstract* thought—the kind of thought that gives dignity to man and produces civilizations. In contrast, many muscular skills—bicycling, running, climbing—may be learned without such thought; but the possible range of such skills leaves man a hunting and hunted biped, without learning sufficiently to build even a crude and darkened city. Again, the brain of early species of man, like that of early members of *Homo sapiens*, was probably not greatly inferior to our own brain; but while such brains were coupled with an incomplete and merely spoken language their possessors remained for tens or hundreds of thousands of years without that power and dignity of thought now usually deemed worthy and native to a human being. Through those long periods the brain functioned effectively for survival, but not for thinking. Many or most men of the last ten thousand years have a similar or only slightly better record. Witness the persistence to our day of belief in magic, in witchcraft, and—even where stringent thoughtful law combats it—the considerable success of the medical quack. Citable too are the few—perhaps valid—contemporary cases of adoption and rearing of a very young boy by African baboons (Lois M. Miller, Science News Letter, July 13, 1940), and of two girls by Indian wolves (Arnold Gesell, Wolf child and human child, Harper and Bros., 1941). The descriptions of the mental powers of these children, at and after their reunion with man, are in accord with the generalizations drawn from the other data sketched above.

The motivation of youngsters for fervent purposeful study and exploration is always sought but only sometimes obtained by able teachers. Youth—in its early struggles with arithmetic, language and history—appears to have as yet no firm assurance that some form of sympathetic magic (accepted for ages by primitive *adults*) does not somehow confer or determine personal worth and destiny. The casual and unobtrusive approach suggested above prudently repeated, seems capable of coping with that residue of magic; it vividly portrays personal worth as the reward of effort; it supplies a new and most exciting view of self—and a far and easy look into reality. Only the biology teacher may be expected to make use of this particular approach to the motivation of learning. And nine of ten American youngsters who do not thus meet this arousing item in high school, will meet and grasp it, if ever, only by accident during their span of life.

# Learning from the Out-of-Doors

JAMES R. DAWSON

"Sometimes the breakfast bacon was burned, the hard ground wasn't easy to sleep on, and there were other trials to endure.

"But all these handicaps were insignificant for 55 boys and girls from St. Clair High School, who received unique education in the classroom of the great outdoors." (Bob Solt, Port Huron Times Herald Reporter)

On May 11, St. Clair High School biology students shouldered their bedrolls, loaded their equipment and set out to study, first-hand, problems in soils, forestry, game management, plant and animal life, which they had previously experienced, vicariously, in the classroom.

This was not a spur-of-the-moment affair. Let me take you back several months and give you a brief explanation of the preparations.

After outlining the Spring Program for the Biology classes, I suggested that a representative group of students meet with me to plan and suggest activities. From this group, the basic areas of interest were formulated and then presented to the classes for approval and modification. At this point the question was where and how they could best accomplish these activities. I turned to the leaders in these various fields from the community: James Tew, U. S. Department of Soil Conservation; Kenneth Duncan, State Conservation Officer; and Michael Monroe, Lakeport State Park Manager, for their suggestions on how we might fulfill our desired program.

During a meeting in March they pointed out the various areas and personnel in the

community who would provide the experiences in which we were interested and the ways in which they would be able to assist us. It was agreed that we would use a 160-acre experimental farm for soil and forestry work and over 6,000 acres of State game land for wildlife management and for experience in the use of firearms. It was also agreed that we would use Lakeport State Park for our Nature Program. This information was returned to the representative committee and, after consideration of the work to be done, it was decided that the only feasible way to fulfill these plans would be to camp in the vicinity of these areas.

Realizing the problems this would involve, committees were established to handle the organization of the various phases, which included such things as chaperons, transportation, food, camping equipment, personal equipment, first-aid, recreation, sanitation, and rules and regulations governing camp activities. These committees functioned with the assistance of staff members in the school and personnel from the community. Those people included were from the Guidance Department, Home Economics Department, Physical Education Department, Nursing, Administration (for financing and transportation), State and Federal Conservation Department and branch offices, County Health Department, County Sheriff's Department, County Medical Association, County Girl Scouts, newspapers and parents. The personnel in another community may vary, but these will amply meet your needs.

While these committees were functioning during noon hours and after school, classroom time was devoted to pre-camp preparation for the specific areas of interest. A constant check was made with the administration for approval and advice and, when the program seemed feasible as well as possible, the parents were called upon for their help. At this time a film from Michigan Outdoors was shown regarding camping programs, and the various committee chairmen presented their reports. The parents responded with great enthusiasm and agreed to help in all possible ways. They requested that a list of necessary equipment be sent to them, which we did. They volunteered their hatchets, spades, hoes, rifles, lanterns, field glasses and their time for chaperoning and preparing food.

In the ensuing three weeks, prior to our camp date, many things occurred simultaneously; the approval of committee reports by the classes, including menus, tent assignments, chaperon assignments and duties; but in particular, a discussion of their own set of rules and regulations governing their conduct, and they were quite insistent on high standards with respect to property and personnel. Group leaders were elected who would be in charge of individual student groups and whose job it was to coordinate the phases of our educational program. Each group consisted of six or seven people selected by the group leaders who considered such things as the student's ability, personality, and experiences. To successfully do this, they pooled the names of all students; then they began to select their groups, picking students who had outdoor experience, one who would be a second leader, etc., and eliminating at the same time any budding romances, or cliques or definite personality differences. Each person in a group, from this point on, was directly responsible to the leader (who had the responsibility of the action and movement of the group at all times), and the leaders were responsible to the instructor. This relieved me of all minute details and left me responsible, only, for matters which could not be handled by the group leaders.

The group leaders and the counselor and I spent one full day in the area, following the exact route to be taken and timing the runs, and checking the location of our camping area in an attempt to foresee any problems which might arise.

The program activities and all pertinent information were compiled in a booklet, and duplicated, so that each student might have a copy. This contained the complete time schedule as well as the orientation material, lists of equipment and brief descriptions of the various areas of work. The student was instructed to take this home for discussion with his parents and to get from them an approval so he could go on the trip and take part in the firearms demonstration.

These and many other problems, which would vary, however, with any other pro-

gram, were ironed out before we found ourselves ready to muster our groups in the gymnasium for loading, the morning we left for camp.

Each group immediately went into action upon arrival at camp, at previously-assigned jobs, such as raising tents, spreading straw, policing the area, cleaning washrooms, raking the beach and gathering firewood. Following this, an orientation hike was taken in the area. The students then sat down to enjoy the bag lunches they had brought.

In the afternoon the groups met as a unit and heard a welcome and orientation talk by Mr. Monroe, the camp director. The students then separated into their groups and on the first afternoon the full program began with the students traveling by school bus, accompanied by parent chaperons, to the various work areas. To facilitate your understanding of the program, it might help at this time to go through a day's program.

4:45 a.m. The group leaders were awakened.

5:00 a.m. Those groups having bird observation were aroused.

6.00 a.m. The other half of the camp was awakened for details and breakfast preparation. These groups alternated in their activities each morning.

7:00 a.m The bird observation groups returned and breakfast was served. Eggs and bacon have a different flavor when cooked over an open fire, and the smell of coffee blends with the smell of firewood.

7:30 a.m. General clean-up for the duty-half of the camp. (Bird observation groups had this time free for personal care.)

8:00 a.m. The groups mustered at the bus loading area to begin the day's activities.

The soils group, upon arriving at their area, experienced problems in soil management, erosion, bank control, etc. The forestry unit was concerned with types and uses of trees, growing and planting of them, in an actual work situation. The wildlife group combined both the practices of game management and also the proper method of handling firearms and conduct in safe search for game. The nature study group, using the general camp area, was able to study the topography from lake shoreline to open fields. They were able to make comparisons of plants and animals within these areas. This group, because of the lack of transportation time, was able to return to camp and set up for the next meal preparation.

12:00 noon: Lunch.

12:30 p.m. Work details.

1:00 p.m. Back to work areas.

5:00 p.m. Supper (where the students were more interested in quantity than in variety).

5:30 p.m. Half the groups were on bird observation and the others were on camp details.

6:00 p.m. The work details mustered for a lecture on camping, types of camping, particularly survival camping.

6:30 p.m. All returned to the area for recreation, such as volleyball, swimming, capture the flag, etc. All activities were supervised by parents for safety purposes.

8:00 p.m. All gathered on the beach for a bonfire, songs, and a general good time.

9:00 p.m. Back to the tent.

9:15 p.m. Group leaders met with me to discuss the following day's program for any changes that might be necessary.

9:30 p.m. Lights out (but not always asleep).

By maintaining the groups in small units, each individual was able to participate. This meant that each specialist presented his work several times, as the groups rotated, by prearranged plans.

We were able to build upon our outdoor experiences upon our return to the classroom by first organizing and discussing the things which had occurred. It was an easier matter, then, to capitalize on newly-aroused interest for additional study.

It is difficult to explain the many and varied experiences these youngsters had, both in things planned for and those things which were a result of good planning. I have attempted to mention, briefly, some of those ex-

periences we had established for ourselves. This article would be lacking, however, if I failed to mention some of the unplanned-for benefits of this trip. It would be impossible for me to list them all, because each individual had some unique experience and awakening that was strictly his own. Through their evaluations of the program and from our observations, it seemed quite apparent that these are a few of the so-called tangent benefits derived from student planning and participation in a program of this type. They began to know each other and to enjoy each other. When placed in situations where they had to work together, they learned to work together. People who before, had only had passing acquaintances, were scrubbing, raking, and becoming friends. When committees placed responsibilities upon individuals and groups they carried out their work in a most satisfactory manner because it was their program. Prodding was necessary, but it was more often showing them where and how to start. Almost without reservation, it can be said that each individual progressed in some way. In some it was greater, but even the student who just took part was making great strides. Some of the barriers broken represent greater advancement than those exhibited in breaking the sound barrier. It should also be mentioned that the students and parents found a renewed interest in each other and a closing of the gap that so often exists between teenager and parent. A few words of caution; do not plan the program for the tangent benefits—they will come by themselves; plan instead for as many educational experiences as you possibly can incorporate into a cooperative program. For it is only then, that all the values can be reaped.

## Our Wildlife Legacy

OUR WILDLIFE LEGACY, Allen, Durward L., Funk and Wagnalls Company, New York. 422 pp. illus. 1954.

If you gave Durward Allen's book only a casual glance when it first appeared in 1954, it's time for a "double-take." Maybe you made that decision when you read Dr. Errington's article in this issue. Our Wildlife Legacy is still a classic. If your students have that "fed-up" look when you mention conservation, try a few discussion starters like these:

1. Suppose severe winter conditions kill most of the bobwhites in central Iowa. How do you think this will affect the rate of increase in bobwhite populations in the next few years?

2. How do you think the productivity of ponds in southern United States compares with the productivity of similar ponds in northern states?

3. How did the American Indian, during pioneer days, rate as a conservationist?

4. Lake Senachwine (Illinois) has an area of about 6,000 acres when the water level is up. The fish population is about 50 to 55 pounds per acre. Drouth may reduce the size of the lake to 3,000 acres in a single year. How will this change affect the lake's yield of fish?

5. How would you expect the population of white-tailed deer to be affected by lumbering operations in a densely forested region in the Lake States?

6. One of the plans for increasing wildlife has been to "store up" the resources by restricting hunting. How would you expect this plan to work?

7. New Hampshire and Vermont have similar habitat for deer. For more than 300 years New Hampshire has permitted hunters to kill either bucks or does. Across the boundary in Vermont the does have been protected for many years. How do you think this difference in hunting laws affects the deer populations in these states?

8. In order to provide hunting, many eastern states have purchased cottontails that were trapped in states farther west, such as Missouri. The rabbits were released in areas where better hunting was desired. How do you think this program succeeded—both biologically and economically?

9. As a biologist, what is your opinion of this argument?—Animals reproduce far more young than are normally able to survive. Predators live on the "surplus." One way to improve hunting conditions is to eliminate the predators, so hunters can get the surplus population.

10. And how does this argument sound?—Some kinds of birds and mammals are harmful to man's interests. Sportsmen want something to hunt. The sensible way to reduce the populations of undesirable species is to offer a bounty for each specimen shot.

If you like your students to distinguish between fact and opinion, you'll like the way Allen handles such questions. He is down-to-earth; yet he does not gloss-over the difficulties of interpreting ecological data.

—Richard Trump
Ames H. S., Ames, Iowa

# The Trade Journals As Resources for Biology Teaching

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The possibilities for better instruction offered by proper use of house organs and the publications of firms dealing with scientific supplies are many and varied. The information found therein is highly accurate, authoritative and very recent. New and fresh ideas are presented for laboratory application. Illustrations are excellent. This semester, for example, materials taken from such sources have formed an important part of daily displays labeled "Biological Briefs," placed strategically before the entrance to the classroom where they will gain ready attention and emphasize a key point in the discussion presented.

The following is a partial list of these journals received regularly from which object lessons are drawn constantly in a variety of ways for teaching purposes. The listing is alphabetical and non-discriminatory. Each one is very valuable in its own right and has more than demonstrated its worth many times.

*Bird Notes*, Phipps & Bird, Inc., Richmond 5, Virginia.

Most helpful in keeping one up to date concerning the latest apparatus for biological, chemical, and physical experimentation, the catchy title refers to the firm name rather than to ornithology. Much that is intriguing occurs in its pages other than the information carried. An example is the quote taken from "The Story of Rheology" by E. T. Severs of the Natvar Corporation, Woodbridge, N. J.

"Mugg parted the curtain of hair shielding his face and peered with eyes blinking to adjust from the cavernous gloom to the brilliance released in the wake of the departed rain. As he stepped into the sunshine, he first felt exhilarated as the chill of the cave melted from him. Then he felt something else. The tops of his toes, not as insensitive as the case-hardened bottoms, were cooled by mud extruded upward between his toes from the pressure of his feet. He stooped and scooped up a handful of the mud and squeezed it in his hand until it oozed between his fingers. He had done this before as countless of his ancestors had done before him, but with this difference. He felt the decreasing resistance of the kneaded mud and a faint spark of curiosity was aroused. He repeated the process, gave a satisfied grunt and winged the mud at a tree. Perhaps this is how Mugg or his like became, for a fleeting instant, the first rheologist or student of flow."

That is epic writing. Do you think your teen-ager or your college freshman would fail to get the picture of Mugg, or escape a glimpse into the depths of primitive man's dawning scientific consciousness, if this passage were read in class as an introduction to an important concept concerning viscosity and blood circulation, for instance? Wouldn't his heart pound a trifle faster with excited anticipation, that is, if he had any imagination whatever? And some do, thanks be. The article continues with an arresting account of the history of flow beginning with the Egyptian Amenemhet of about 1540 B.C. and ending with Poiseuille who traced facts concerning human circulation.

*Carolina Tips*, Carolina Biological Supply Co., Elon College, N. C.

The December 1956 issue has an index for the year from which a few titles are given to show the possibilities of the articles as teaching aids: Artificial Stimulation of the Egg-laying Response in Frogs; Setting up an Aquarium; Aspirator for Use in Fixing Plant Tissues; Development of Mealworms; Fern Sperms; Preparation of Herbarium Specimens; Laboratory Exercises in Genetics; More Animal Facts and Myths; Mosquito Culture: This same issue has a description of *Pandorina* with a life

cycle diagram accompanying, by Dolores Bejewski of Mundelein College, Chicago. Be sure to request this publication. It's good.

*Clinical Symposia*, Ciba Pharmaceutical Products, Inc., Summit, N. J.

A journal, published mainly in the interests of the medical profession but first class for any biologist, which appears once every two months and always welcome. It invariably contains authoritative articles featuring diseases. The illustrations are many and fine. The Nov.-Dec. '56 issue is devoted particularly to the timely subject of cirrhosis and is highly graphic.

*Cenco News Chats*, Central Scientific Co., 1700 Park Road, Chicago 13, Ill.

The biographies of some of the great men in modern science are featured regularly. Number 83 for 1956 tells of the admirable life and work of Dr. E. J. Cohn, outstanding investigator of blood chemistry at Harvard for many years.

*Digest of Biology* and *General Science*, W. M. Welch Scientific Co., 115 Sedgwick St., Chicago 10, Ill.

Excellent digests of important articles, prepared by Dr. Richard R. Armacost, co-editor of the *American Biology Teacher*, provide a great many suggestions for the enterprising science and biology instructor, as well as hours of instruction and worthwhile enjoyment in accessible form.

*The Educational Focus*, Bausch and Lomb Optical Co., Rochester 2, N. Y.

Anyone who has experienced the sparkling and often subtle humor tucked away in the technical but absorbing articles of Dr. David Causey on parasites and their kin which appear from time to time in this periodical needs no further recommendation for keeping the copies close by for consultation with the inevitable chuckles, or even guffaws, they arouse. Every issue has many items of value centered around the microscope and its uses.

*Laboratory*, Schaar and Co., 754 W. Lexington St., Chicago 7, Ill.

Although much included here relates to chemistry there is challenge for the biologist as well. The "Accidental Scientific Discoveries" featured have proved enlightening and absorbing. The smear technique as developed by John Belling in chromosomal studies of crushed anthers was particularly appealing.

Pfizer *Antibiotics News Letter*, Pfizer Laboratories, Brooklyn 6, N. Y.

This is devoted to reporting up to the minute research on antibiotics. The special issue, covering the fourth annual symposium held in Washington, D. C., October 1956, was especially complete and instructive.

*Progress through Research*, General Mills, Inc., Research Laboratories, 2010 E. Hennepin Ave., Minneapolis 13, Minn.

A quarterly of great interest to anyone having to deal with foods. The article on "Food Irradiation" by Drs. Henry and Andrews, Vol. 10 for 1956, with its excellent illustrations and graphs, is but one sample of the fine articles encountered.

*Research Today*, Eli Lilly Research Laboratories, Indianapolis 6, Ind.

Every issue is a gem in medical knowledge of the latest kind. The issue of Vol. XII, No. 1, 1956, on "Experimental Cancer Research" is superb in every respect. A fine bibliography accompanies each article. A list of current research papers is in each issue, many being free for asking.

*The Sugar Molecule*, Sugar Research Foundation, Inc., 52 Wall St., New York 5, N. Y.

This specializes on sugars and other carbohydrates with their many uses.

"Combating Food Misinformation" is a representative title from Vol. 10, No. 1, for the summer of 1956. Excellent articles, very well written.

*Therapeutic Notes*, Parke, Davis & Co., Detroit 32, Mich.

It matches any of the medical trade journals in accurate and relevant facts, in variety of appeal and quality of production. The "Famous Firsts" which appear regularly have dealt with the hearing aid, percussion hammer, rubber gloves, silver suture, operating table, scalpel, colorimeter, and those instruments so indispensable to medical practice. Books are reviewed, "10 second abstracts" on medical news items occur, with every copy full of interest.

*Turtox News*, General Biological Supply House, Inc., 8200 So. Hoyne Ave., Chicago 20, Ill.

If you are one of the 50,000 biologists who receive this treasured organ monthly you need no statement of its worth. A wide spread of articles appears in its pages. It offers an excellent medium, courteously and generously, for reports on much investigation which probably would not otherwise get into print.

Ward's *Natural Science Bulletin*, Ward's Natural Science Establishment, Inc., Rochester 9, N. Y.

Long a leader in supplying high quality materials to biology and geology laboratories this company is well and favorably known for its "Bulletin" and separately published "News Letter." The autumn issue carries a firsthand account of dogfishing operations on the Maine coast, a timely recital which could not help but create pleasant recollections in the minds of sea-goers, especially natives of the rugged Pine Tree State.

If you are a biology teacher at any level, you will find many items of usefulness in each of the house organs listed. Why not write to one or more of the parent companies asking that your name be added to their mailing list? If your experience is as expected you will receive cordial compliance with an outcome most rewarding to yourself and your students.

# Dialogue on the Neuro-Muscular Mechanism

JOY WHEATON

*Shimer College, Mt. Carroll, Illinois*

Characters:

Chordata ..... Chor.
Arthropoda ..... Arth.
Mollusca ..... Moll.
Annelida ..... Anne.
Platyhelminthes ..... Plat.
Coelenterata ..... Coel.
Porifera ..... Pori.

Chor: Ouch! There it goes again—our daily torture.

Pori: What are you all jumping around about? I don't feel anything.

Chor: That's just because you have no nerves to feel the electric shock the experimenter is putting through this pool. You couldn't jump anyway, because you have no muscles to jump with!

Pori: Maybe I can't feel things, as I don't have any nerves, but you're way off when you say I can't move. I have a perfectly good muscle around my mouth. Just put your fin in it, and I'll show you whether I can move or not.

Chor: All right; so if something hits it, your muscle will contract, but you can't just make it contract. Now with me, I have nerves and muscles all over my body, so I'm really suffering.

Coel: What are you griping about, Chor.? At least if half of you is out of the water, only the half that's in will feel the shock, since your brain is a central meeting place where all your pains report and get sorted out. Even if a mere fraction of one of my tentacles is in the water, I feel it all over my body.

Chor: I really pity you poor, lowly creatures. To have every sensation diffused over your entire body must be confusing. When someone sticks a pin in you, how do you know where you've been stuck, and which part of you to withdraw?

Coel: I don't. That's the trouble. It's because we have this silly diffuse nervous system. Our nerves connect directly with the muscle they stimulate as well as with other nerves; and, since impulses may travel in any direction in our nerves, each nerve passes the sensation on to the next which stimulates its muscle and passes it on again. Thus may whole body is thrown into turmoil by one pin prick.

Chor: You should have nerves like mine. Then impulses can travel in just one direction. That way is more orderly. But at least you do have nerve and muscle connections all over you which is more than Pori. has. If only you had some regulating center to which all your nerves would be directed.

Plat: Why even I, lowly as I am, have that. I can wiggle my tail away from a lighted cigarette without moving all of me. This is because I can coordinate my muscles, due to the presence of ganglia, or aggregations of nerve cells, in my body. Each nerve receives the stimulus, transfers this to the nerve center, and then another nerve carries it back to the muscle to make it move.

Chor: Just don't be quite so high and mighty, Plat. Nearly every motion you make is purely reflex. It never gets to your so-called brain at all. All your brain is anyway is a pair of slightly enlarged ganglia. They have the optic nerve going to your various eye spots, but not much else. True, you do have a couple of nerve cords leading from your brain back through your body, so I suppose it might conceivably be possible for a stimulation at your tail to eventually reach your brain, but it would be a slow process.

Plat: You'll have to grant me one thing—all you "superior" animals follow the same basic nerve-center-nerve-muscle pattern that I originated.

Chor: Well, yes. And you are capable of bending your body, since unlike the Coel. you have oblique muscles as well as longitudinal and transverse. But you don't even have a heart or blood, and a heart is one of the most important muscles of all.

Anne: I can help you out there. While you may not consider my heart a real one, it is good enough for me.

Chor: Bah! All you have are vessels which can be contracted to force your life juices along. That's no heart.

Anne: But you do admit that I have pretty effective muscles. And I don't even have to think to make them contract; they're automatic. My whole body wall is composed of muscle derived from my mesectoderm. In each segment I have longitudinal muscles to make me shorter and circular ones to make me longer, besides little muscles to move my setae and parapodia.

Chor: With all this brawn you claim, you must have some brain. How about it?

Anne: A good bit more than my lowly relative Plat., I guess. I have a pair of large ganglia for a brain. It has definite centers for my different senses—association centers you'd call them. That isn't all, either. I have ganglia for each segment of my body, but they're not nearly as independent as Plat's. are. I have what you call giant nerve fibers running from the ganglia directly to my brain. This is for speed in conveying impulses. Besides the ordinary sense cells of seeing, smelling, and feeling, I have some special cells which secrete a substance very similar to your adrenalin.

Chor: I never realized you were so nearly like us. You're actually pretty well developed for your size. Look at poor Moll. over there. He's always worrying about that precious foot of his, and now I suppose the electric shock has irritated the tender thing. I guess that part of him has a right to be particularly sensitive though, since the rest of him is so well covered up by shell.

Moll: All right, I may not hear so well, but I am sensitive and do have feelings. I can boast of something that no one of you has previously said you had and that's a real heart. I have two auricles and a ventricle. Even if it isn't quite strong enough to pump my blood throughout me and does require a few auxiliary hearts along the way, it's still a lot more than the rest of you have, except you, of course, Chor.

Chor: Heart isn't everything, even though it is important as a muscle. I'd rather be heartless, like Anne. and have a good brain, than have the most magnificent heart in the world and be as stupid as you. You don't even have as much brain as Anne. True, in your higher forms the front pair of ganglia is a little more important than the other two pairs, but

there is not a great amount of difference. In your highest form you even manage to have them all fused into a ring, but no matter whether they are in the latter form or diffuse, it makes little difference as far as muscle co-ordination goes.

Moll: I'll have you know my entire mode of locomotion is dependent on muscle.

Chor: That's probably why you're so slow.

Moll: That may be, but I can pull 19 times my weight. In the water, I draw water into my mantle cavity and then by pure muscle expel it so forcibly through my funnel as to provide a sort of jet propulsion. What could be more modern? My foot itself is highly muscular, so it is natural for me to want to protect it. I even have jaws which none of these others has had. They too are very strong for their size.

Chor: I'd still rather have brain. Then you don't need so much brawn.

Moll: If you want specialization, I even have statocysts to aid in retaining my balance in the water.

Chor: Yes, but where are they? In your brain, like my organs of equilibrium are? No, they're down around that foot of yours. I've heard of brains in the feet.

Arth: I can top you all. I have my brains in my head, to satisfy Chor., plus a heart and other important muscles.

Anne: Don't think you're so advanced. You inherited your nervous system from me. You may have a brain bigger in proportion than mine, but you too have ganglia in every somite of your body, as I do for each segment of mine.

Arth: But my nervous system is more nearly like that of the vertebrate. I have organs of taste, smell, hearing, sight, feeling, temperature and humidity. My eyes are compound and I can tell colors. Some of us can even remember things, the bees and ants; and the bees and wasps seem to appreciate a sense of time.

Chor: But if I were to cut out your brain, you could still walk; or if I separated your abdomen from the rest of you, it would still lay eggs. Your brain isn't so all-fired essential. As a matter of fact, you're mainly instinctive in behavior. Even your muscles aren't so hot. One heart isn't enough to pump blood through such a small organism as you are. You almost literally don't have a leg to stand on. The segments of those of you with hard exteriors are manipulated by muscle strands, so you are relatively easy to break to pieces.

Arth: Oh, you just like to criticize everybody. Do you know that in our goat-moth caterpillar there are 4,061 distinct muscles? Some of us can beat our wings 300 times a second. In those of us that are soft-bodied, the muscle tone of our body walls can change the pressure on our blood which then acts on those places in our body where the muscles are relaxed, producing movement.

Chor: I hate to disillusion you, but the only reason you can beat your wings so fast is that your muscles in reality contract rather slowly and set up a vibration in the walls of your thorax to which your wings are attached. As for your method of locomotion, it must take an awfully long time, relatively speaking, for your muscles in one place to contract, relax in another, and be pushed by the pressure applied by the first set to a liquid medium which then pushes the second set.

Arth: I'll have to remind you that we're the most numerous of any of the phyla now existing. We can't be too poorly constructed if we're more numerous than even you, great Chor.

Chor. Quality, not quantity is the word, my dear fellow. Which others of you can solve a mathematical problem or ponder about your soul, as some of us can? Who else here can wonder what the morrow will bring, or set to work to logically locate and destroy the origin of this electric shock that started this whole discussion?

Moll: Perhaps some of you are wonderful, but even a fish like you has only an auricle, a ventricle, and a sinus venosus for a heart. I have *two* auricles and a ventricle.

Coel: My diffuse nervous system, bad as it is, is quite good enough for the digestive systems of all of you, Chor.

Anne: Even I have as good and specialized a brain as your Amphioxus. They don't even have paired nerves to the eye spots.

Chor: Hold on a minute. There's one little item that makes all the difference in the world. We all have a nerve cord above either a notochord or a backbone. This nerve cord gives rise to pairs of sensory and motor nerves. The dorsal roots are both sensory and motor in the lowest forms, but the ventral are motor only. In no other phylum can you find this distinguishing trait. But in addition to this fundamental difference, there are many even more complicated specializations, and the very least of us show more complex development in our neuro-muscular mechanism than the rest of you. Each muscle must be stimulated by a motor nerve before it can change its form. The motor nerve must have been stimulated by a nerve cell body in either the nerve cord or brain. The central nerve cell must in turn have been stimulated by a sensory nerve. Thus there are at least 3 nerve cells involved in every reaction.

Pori: Since we all seem pretty well satisfied with ourselves, and since we all seem to be getting along pretty well in our present states, let's forget the quibbling. After all, if we were all the same, we'd all want the same food and feel the same things. Then we'd be killing one another instead of living in peace and quite.

Chor: Much as I hate to admit it, I do believe you are right. We have seen in comparing one another the relation of the physiological function to the morphological specialization. It is this relationship which determines and fits us for our particular niches in the complex and grandiose scheme of life.

### Killing Viruses

—X-rays seem to kill some viruses by scoring a single direct hit on the nucleic acid core that lies—like a bullet in a rifle barrel—inside a virus' protein shell.

## Conservation Education Directors Meet

Ten directors of the National Conservation Education Association met at Purdue University last month to organize plans for the coming year. Left to right around the table are: F. Olin Capps, Missouri Conservation Commission, Jefferson City, Mo.; George Worley, Iowa State Teachers' College, Cedar Falls, Iowa; Charles Mattison, U. S. Forest Service, Washington, D. C.; Fred Schmeeckle, Wisconsin State College, Stevens Point, Wisc.; Everett Dawson, Texas Game and Fish Commission, Austin, Tex.; Howard H. Michaud, associate professor of conservation at Purdue and president of the group; Stanley Mulaik, University of Utah, Salt Lake City; Robert Finlay, Ohio Conservation Education Supervisor, Columbus, Ohio; Douglas Wade, South Carolina, Conservation Commission, Columbia, S. C.; and Wilson Clark, Eastern Montana College of Education, Billings, Mont.

# Toward Improvement of Advanced Undergraduate Biology Courses

JOHN A. BEHNKE, Chairman
*Subcommittee on Instructional Materials and Publications*
*Committee on Educational Policies*

Many biologists have noted that college courses and textbooks often fail to keep pace with advances in the biosciences. What causes concern is not that discoveries inevitably somewhat outdate any book before it can be printed, nor the omission of specific research results. Rather, what is serious is the inertia impeding the redirection of instruction in accord with fundamental changes in many fields during recent decades. Courses may also have inadequate regard for changing student needs; students must be prepared for the biology of 1970 and 1980, not that of 1900 or even 1950. Obviously, the complexity and amount of information in any field dictate severe selectivity in designing courses. It matters greatly how that selection is made if the student, in the limited compass of a course, is to be given a foundation that will serve well for the future. But tradition and the fact that a college professor may be asked to teach subjects in which he is not expert often lead to the persistence of more or less anachronistic patterns of teaching.

The Committee on Educational Policies of the Biology Council, Division of Biology and Agriculture, National Academy of Sciences–National Research Council, has proposed a method for meeting this situation. The plan can be applied to any field by any responsible and informed group. The Committee itself, aided by a grant from the National Science Foundation, will test the plan in two subjects. If trial indicates that the approach is sound, the Committee hopes that the demonstration will encourage professional societies and others concerned with particular subjects to sponsor similar studies.

Basically, the idea adapts the research conference technique to the development of courses, recognizing that, even in a limited field, one person's knowledge and wisdom rarely suffice. For a subject considered by those in the field to need scrutiny, an *ad hoc* panel would be set up, composed of biologists who represent different facets of the discipline and whose competence in research, experience in teaching, and flexibility of thought are generally recognized. The panel would make a wholly fresh start in designing the course, putting present practices aside in so far as possible. It would first consider what function the course should serve, what understanding and information students who take the course —or might do so if it were properly developed —need. This question should not be interpreted as stressing applications alone; undergraduate courses should primarily contribute to the student's maturation as a biologist through emphasis on broad comprehension of principles. Keeping these objectives and the present state of our knowledge in mind, the panel would then define topics to be included and the place and weight assigned to each, noting what time-worn material may be eliminated, what sequential treatment will most effectively impart a coherent picture of the subject as an area of systematic knowledge and, especially, as a sphere for continuing inquiry. Through correspondence and meetings, the panel would exchange ideas and tentative outlines until they evolve an acceptable, fairly detailed program, perhaps with suggestions for variations. Finally, the panel would publish its report, exposing it to professional criticism and making it available for the guidance of teachers and authors. The panel would then disband, for the objective is not to replace one orthodoxy by another, but rather to initiate what should become a continuing process of periodic re-evaluation of courses.

The trial involves panels on Parasitism and Systematic Botany. After considering many

suggestions from a variety of sources, including the American Society of Parasitologists and the American Society of Plant Taxonomists, panel members were selected by the Committee and appointed by the Chairman of the Division. The panels are now at work; reports due by June 30, 1957 will be published in journals or through the Academy-Research Council. Both panels will be glad to receive suggestions and ideas on the form and content of undergraduate courses in their subjects.

The *ad hoc* Panel on Systematic Botany Courses includes Lincoln Constance, University of California (Berkeley), Chairman; Harlan Lewis, University of California (Los Angeles); Reed Rollins, Harvard University; Robert Thorne, State University of Iowa; and Herbert Wagner, University of Michigan.

Members of the *ad hoc* Panel on Parasitism Courses are Clay G. Huff, Naval Medical Research Institute, Chairman; L. O. Nolf, State University of Iowa; Richard J. Porter, University of Michigan; Clark P. Read, Johns Hopkins University; A. Glenn Richards, University of Minnesota; A. J. Riker, University of Wisconsin; and Leslie A. Stauber, Rutgers University.

# A Study of the Factors Affecting the High School Student's Choice Regarding a Science Career

MAURICE FINKEL
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This study was made to discover why students at the high school level chose to enter fields of endeavor other than science. It was believed that students have been exposed to certain conditions in the school which were of influence in their final choice of a career. Some of these factors could have been: (a) the interest in science shown by the teachers; (b) the guidance received by the students; (c) the provisions made by the school in regard to the facilities and the use of the laboratory as an instrument of learning; (d) the availability to the students of supplementary science activities; (e) the presentation by the school of the courses in science and mathematics necessary to provide students with the fundamentals in those areas.

To implement such a study, questionnaires were sent to staff members in a group of secondary schools of various sizes and locations. A number of schools in the State of Colorado were chosen to receive these forms as well as a similar number of schools in various other parts of the United States. Returns were made by twenty-one schools involving the participation of twenty-one principals, sixty-five science teachers, twenty-four guidance counselors and 594 senior students. The students who took part in this research were chosen from classes which would best provide a picture of the typical student. Some of them were interested in science and many were not. In addition to the information offered by the high school students, fifty-six college freshman who were enrolled in the Basic Communication classes of the University of Denver also returned similar questionnaires for the purpose of comparison.

As a result of personal contact with many principals as well as the information provided by the questionnaires, it appeared that a large proportion of these principals: (a) were not too well aware of the nation's critical need for personnel trained in science; (b) were more interested in keeping poorly qualified students out of science areas than in guiding potential scientists into the field; (c) were quite blind to the academic inadequacies of their science teachers as well as to the poor science teaching situations that were the result of inadequate laboratories, science texts and supplementary science activities; (d) were apparently satisfied that as long as the physical sciences and the more advanced courses in

mathematics were offered on alternate years, or for that matter each year, that such courses were available to all the students who desired them. Regarding this latter point, there was considerable evidence that in a number of the selected schools, the physical sciences and the more advanced courses in mathematics needed by students interested in a science career were offered only once or twice a day. The result of this procedure was that they often conflicted with courses regularly required for graduation thus denying to many students the opportunity to take them.

Regarding the science teachers, there was much evidence to indicate that a large number of them: (a) were teaching a science which was not their speciality; (b) were in many cases teaching non-science subjects; (c) were in most cases carrying two or more periods of extra duty of a supervisory nature; (d) were providing no formal laboratory sessions along with their regular science classes; (e) were without even an undergraduate minor in the science they taught. In this latter respect, few of these teachers had taken any graduate work in either their teaching field, in related sciences including mathematics or in the methods of teaching science. However, most of these science teachers had taken some graduate work in the area of professional education.

The guidance teachers were all quite well educated in their speciality, but for the most part had indicated little interest in science. Most of them carried teaching and supervisory loads in addition to their counseling.

A large majority of the high school and college students which participated in this study were aware: (a) of the inadequate facilities and space in the laboratories; (b) of the lack of student time spent in the laboratory; (c) and of the need for more supplementary science activities and science texts. The better science students indicated that they were constantly retarded by the slow pace set by the teacher. Many of these students recognized the academic unpreparedness of their teachers.

In response to a question regarding their interest in nine commonly taught grade school subjects, the overwhelming majority of these students listed reading, arithmetic and science as the most interesting studied while they were at that level. About one-third of these students stated that while at one time they were interested in a science career, they had since changed their minds, nearly all of them having had done so while in the senior high school. The implication was that most students have a natural interest in science but that some place along their school career, particularly in high school, this interest was dampened. Most of these students did not take more than two courses each in mathematics and science between grades nine and twelve. The more science and mathematics a student took, the greater seemed his interest in a science career. There were a large number of instances where students had indicated interest in entering a science field but had, at the same time, taken fewer than two courses each in science and mathematics.

The principals, guidance counselors, science teachers and high school students were all in general agreement that the primary reasons why students did not take more science while in high school were because: (a) science was too difficult and involved too much mathematics; (b) the student's background in science while in elementary school had been poor and uninteresting; (c) because the school offered so many important and desirable courses in competition with science that students found it difficult to make the proper choice. However, there was some evidence that a much smaller proportion of the students avoided taking science because of its difficult nature than was implied by the principals, guidance and science teachers. Apparently, the fact that science may have been considered more difficult than other courses was not the final reason why high school students were not taking them.

## RECOMMENDATIONS

The graduate schools in the nation should develop a Master of Science Teaching degree program designed specifically for secondary science teachers which would enable them to take a large part of their graduate studies in their teaching fields. Science courses for teachers carrying graduate credit which are fairly elementary would be necessarily a part of this program in view of the inadequate science background of many of these teachers.

Such courses as Earth Science for Teachers, Organic Chemistry for Teachers, Human Anatomy and Physiology for Teachers, Survey of the Plant Kingdom for Teachers, etc., which ordinarily may not be offered for graduate credit should be acceptable toward a Master of Science Teaching degree. A refusal to do so would only send the teachers who need these more elementary courses back to the schools of education for a graduate program containing only courses in professional education. Certain courses in education may be fitted into these studies toward this degree including methods of science teaching. In a similar fashion, graduate schools may offer a Doctor of Science Teaching degree for the individual interested in college teaching. All the courses for this degree should be at the graduate level and consist of studies in specialized science areas supplemented with appropriate courses in professional education. The prime purpose of such a degree program would be to prepare scientists for college teaching and not just science research.

The undergraduate colleges involved in teacher preparation must offer a sequence of studies which will insure the elementary school teacher and the secondary school science teacher of the broad fundamentals of science. The future elementary school teacher must have at least an acquaintance with course work in general biology, human anatomy and physiology, conservation of our natural resources, physics, chemistry, earth science and astronomy. Wherever possible, they should be expected to participate in individual laboratory work in order for them to develop an ease in the performance of classroom science demonstrations. Some background in the history of science and science teaching methods would also be helpful. They should have at least one general mathematics course along with methods of teaching arithmetic.

The student of secondary school science teaching should take some individual course work in botany, zoology, human anatomy and physiology, physics, chemistry, earth science, astronomy and the conservation of our natural resources. Upon the completion of the basic courses in these areas, he should specialize, at least to the level where, upon graduation, he would be advanced enough to take the regularly designed graduate courses in science should he return for a master's degree. He should have college mathematics up through calculus in addition to courses in the history of science and science teaching methods.

In order to attract better qualified people into science teaching, it may be necessary to provide them with a subsidy similar to that given teachers of agriculture. The position could also be made more attractive if the science teacher was relieved of non-teaching supervisory duties. Extra time would then be applied toward the building of a laboratory and a supplementary science activities program. The salary of the science teacher should be determined by merit rather than by time in service alone. Criteria, by which merit may be partially determined are: (a) the extent of the education of the teacher; (b) the accumulation of college credits in the subject of his teaching and related fields; (c) the nature of the science program developed by the teacher in his school; (d) the contributions made by the teacher to science and science teaching organizations.

The employment policies of school boards must be adjusted to meet the needs of the times. Able science teachers should not be retired or refused employment simply because they have passed a certain age level. Certainly unqualified science teachers should not remain in teaching because of tenure. They should be expected to improve their background within a reasonable period of time or be recommended to the school board for dismissal. As an aid to evaluate the science background of teachers, a neutral organization, such as the United States Office of Education should set up and sponsor a series of standarized examinations. Such examinations may be used by school boards as a guide to the evaluation of science teachers before employment as well as for those who have been with a school system for many years. In a similar way the science background of the grade school teacher could be measured.

Elementary and secondary schools should have someone on the staff whose education in science would qualify him to be the school's science counselor. The duties of such a person

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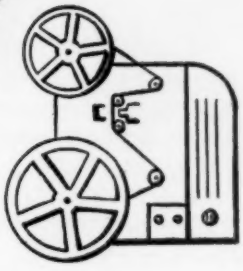
# A-V NEWS



EMERY L. WILL

*State University Teachers College, Oneonta, New York*

The use of microprojectors and overhead projectors in secondary schools and colleges continues to increase, along with expanded opportunities for first-hand microscopic work by individual students. One of the recent additions to the overhead projector line is the new Master Vu-Graph, which features improved illumination, decreased weight, easier access to the interior of the instrument, and a line of accessories. Charles Beseler Company, 219 South 18th Street, East Orange, N. J.

The Bleeker Phase Contrast Microscope "S" offers a lightweight, smoothly focusing instrument which also has a high rigidity. Its features include a built-in stop; dustproof objectives 2X–90X; use with or without phase contrast; wide range of accessories. Karl Heitz, Inc., 480 Lexington Ave., New York 17, N. Y.

New to the enlarger field is the Primos Junior Enlarger, which allows automatic focusing for magnifications from two to ten diameters, and hand focusing for larger sizes. This lightweight instrument has a 50mm., f/3.5 lens, and a tiltable head. Karl Heitz, Inc., 480 Lexington Ave., New York 17, N. Y.

### RECENT FILM AND FILMSTRIP RELEASES

*BASIC NATURE OF SEXUAL REPRODUCTION.* 16 min., sd., color. The most recent film in the excellent *Continuity of Life* series. High school and college. Division of Adult Education and Public Services, Indiana University, Bloomington, Ind.

*FROM THE GROUND UP.* 14 min., sd., color. The soil scientist and his work in mapping farm soils; introduction to soil surveying tools; importance of productive soils to world food problems; use of soil information in preparing a farm conservation plan. Secondary schools and up. U. S. Department of Agriculture, Washington 25, D. C.

*SEED DISPERSAL.* 11 min., color, sd. The methods whereby seeds become dispersed in nature; time-lapse photography allows showing of detail of movement of seeds. Elementary. Encyclopedia Britannica Films, 1150 Wilmette Ave., Wilmette, Ill.

*MEIOSIS.* 12 min., sd., color. Animation shows details of first and second meiotic divisions, following an introductory flow chart of the fertilization-meiosis cycle. Sponsored by Commonwealth Scientific and Industrial Research Organization, Australia. College. International Film Bureau, Inc., 57 East Jackson Blvd., Chicago 4, Ill.

*BEHIND THE SCENES IN A MUSEUM.* Filmstrip, 23 frames, b & w. The step by step procedures in collecting, preparing and assembling the specimens from an African safari for an animal exhibit. General. Visual Education Consultants, Inc., 2066 Helena St., Madison 4, Wis.

*THE LADYBIRD STORY.* 11 min., sd., color. The life cycle and economic significance of the Vedalia ladybird beetle, and how it was introduced into California to control the cottony-cushion scale. Jr. high and up. Pat Dowling Pictures, 1056 So. Robertson Blvd., Los Angeles 35, Calif.

*EARTHWORMS.* 11 min., sd., color. The earthworm at work in the soil; physical adaptations to under-surface life; birth of young individuals. Upper grades and up. Pat Dowling Pictures.

*TOADS.* 11 min., sd., color. Life cycle and adaptations of the familiar toad. Protective means and food procuring technique. Upper grades and up. Pat Dowling Pictures.

*PLANKTON.* 10 min., sd., color. Plant and animal life inhabiting the fresh and salt water planktons; composition and contributions as food sources. Upper grades and up. Almanac Films, 516 Fifth Ave., New York, N. Y.

*PLANT TRAPS.* 11 min., sd., color. Second edition of William Harlow's original "Insect Catchers of the Bog Jungle," Highlighting the insect eating characteristics of carnivorous plants. Jr. high and up. Encyclopedia Britannica Films.

*LET'S CATCH REPTILES.* 10 min., sd., color. How to catch, care for, and study lizards, tortoises and snakes. Intermediate grades and up. Bailey Films, Inc., 6509 De Longpre Ave., Hollywood 28, Calif.

## CAREER CHOICE

*(Continued from Page 120)*

would be, in part, to organize the science program at each grade level (particularly in elementary school) and to be that special person to whom science interested students are sent for counseling.

It is suggested that the United States Office of Education advise school boards and administrators of the manpower needs of the nation. This organization should take the lead in suggesting to the schools the nature of the science and mathematics program needed by students planning to enter a science career. It could also advise state boards of education and regional accrediting agencies of the science background needed by teachers of secondary school science as well as by elementary school teachers. The United States Office of Education should help the states work out a system of reciprocity by which a teacher certified in one state would be automatically certified in all states.

The secondary school curriculum should include at least the four basic sciences; general science, biology, physics and chemistry, and the five basic courses in mathematics: algebra one and two, geometry, trigonometry and solid geometry. These courses should be available to all students desiring to enter science fields. At least one period a week for laboratory work or demonstrations should be formally set aside for each science course offered by the school.

It is recommended that, with local, state and federal aid, students interested in science be helped to pursue their studies through undergraduate, graduate and even post-graduate school should their potential for learning extend that far. In a similar manner, colleges and universities should be helped to establish programs which would attract top-flight scientists back to the schools for instruction and basic research.

Most young people in their formative years find things related to science of interest. Somewhere along their school career, this interest often wanes and may even be extinguished. The cause for this lies somewhere in the school, in the preparation of the teachers, in their psychology of teaching, in the facilities of the school plant and in the guidance and motivation received by the students. A large part of the problem will be overcome when the school places on its staff scientists who are teachers and not just people who are science teachers. To aid in this respect the positions for teaching science in secondary school must be made more attractive. Salaries should be more comparable with science positions outside of teaching. The teacher of science must be relieved of supervisory extra duties in order to spend more time in developing a laboratory and supplementary science program as well as to aid in the guidance and counseling of students interested in a science career.

# Snyder to Talk in Iowa

Dr. Laurence H. Snyder will address the 69th annual meeting of the Iowa Academy of Science, April 26-27, at Iowa State Teachers College. Dr. Snyder is Dean of the University of Oklahoma graduate school. The announcement was made by Dr. W. F. Loehwing, President of the Academy.

Dr. Snyder, a graduate of Rutgers, and Harvard Universities, has been professor of medical genetics and dean of the Oklahoma University graduate school since 1947. Prior to that time, he was chairman of the zoology department at Ohio State University.

The Junior Academy of Science, sponsored by the Iowa Academy and affiliated with the Science Clubs of America, also met, on April 5, at the Teachers College.